PHYSICS (PHYS-GA)

PHYS-GA 1500 Elect for Scientists I (4 Credits)
Typically offered occasionally
Linear circuit theory, active components, and basic principles of circuit design. Topics will include measurement techniques, noise reduction, filters, and signal detection and processing. The course will also feature an introduction to the use of microcontrollers in a laboratory setting. Open to students in the sciences and engineering.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2000 Computational Physics (4 Credits)
Typically offered Fall
Emphasis is on current research where numerical techniques provide unique physical insight. Applications include, among others, solution of differential equations, eigenvalue problems, statistical mechanics, field theory, and chaos.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2001 Dynamics (4 Credits)
Typically offered Fall
Classical mechanics of particles and extended bodies from the Lagrangian and Hamiltonian points of view. Applications to two-body problems, rigid bodies, and small oscillations. Classical mechanics of particles with emphasis on Hamiltonian description. Ideal and viscous fluids.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2002 Statistical Physics (4 Credits)
Typically offered Spring
Explaining the emergence of macroscopic properties in systems characterized by many degrees of freedom. Thermodynamics: heat and work, entropy, free energy and thermodynamic ensembles. Liouville's theorem. Kinetic theory of gasses, including the BBGKY hierarchy and the Boltzmann transport equation. The microscopic nature of thermodynamic equilibrium: equilibrium ensembles as microscopic constraints. Grand ensembles. Quantum statistical physics, including degenerate quantum gasses. Mean-field theory with applications to magnetism and superconductivity.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2003 Mathematical Methods I (4 Credits)
Typically offered not typically offered
Basic mathematical methods required for understanding of physics and research in physics. Vector and tensor analysis; linear transformations, matrices, and eigenvectors; complex variables, differential equations; Legendre and Bessel functions; integral equations; Green?s functions; group theory; calculus of variation.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2005 Electromagnetism I (4 Credits)
Typically offered Spring
General principles and diverse applications of electromagnetic theory; electrostatics and magnetostatics; boundary value problems; Maxwell's equations; electromagnetic waves, wave guides, simple radiators, and diffraction; plasma physics and magnetohydrodynamics; special theory of relativity.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2011 Classical and Quantum Mechanics I (4 Credits)
Typically offered Fall
The goal of this course is to learn the essentials of classical dynamics ($\hbar=0$) using methods that segue naturally into the study of quantum mechanics ($\hbar=1$). Roughly the first 60% of the course will be classical mechanics and the last 40% quantum mechanics. Classical topics will include Hamiltonian and Lagrangian mechanics, the variational principle, symmetries and Noether's theorem, Legendre and canonical transforms and phase space, Poisson brackets and generating functions, Liouville's theorem and Hamilton-Jacobi theory, action-angle variables and canonical perturbation theory, adiabatic invariance and the KAM theorem, and the basics of fluid dynamics (optional). Quantum topics will include Hilbert spaces, probability and measurement, the Hamiltonian and time evolution, symmetries and conservation laws, mixed states and entanglement, coordinate and momentum representations, bound and scattering states in 1D quantum mechanics, coherent and squeezed states, propagators and the path integral, and the WKB approximation and Bohr-Sommerfeld quantization.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2012 Classical and Quantum Mechanics II (4 Credits)
Typically offered Spring
The goal of this course is to learn quantum mechanics and apply it to single particle or two particle systems. Students will be introduced to approximate methods which are very important for real world applications where exact solutions do not exist. Topics will include: Rotation group, orbital and spin angular momentum, spherical harmonics, Clebsch-Gordon coefficients, Schrodinger equation in 3D, Identical particles, Time-independent perturbation theory, Variational method, Time-dependent perturbation theory, Fermi's golden rule, Interactions with electromagnetic radiation, Aharonov-Bohm effect, absorption and emission of radiation, Landau levels, Scattering theory, Unitarity and optical theorem, Time delay, resonances and bound states, Eikonal (WKB) approximation for scattering.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2015 Introduction to Condensed Matter Physics (4 Credits)
Typically offered Fall
Crystalline lattices, lattice vibrations, electronic structure of crystals, spectroscopic methods, linear response theory, semiconductors, mesoscopic systems, two-dimensional systems (graphene, Moiré materials), Anderson localization, Fermi-liquids, magnetism, Bose-Einstein condensation and superfluidity, superconductivity.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2016 Theory of Condensed Matter Physics (4 Credits)
Typically offered Spring
Topological Insulators and Topological Superconductors. (SSH model, Kitaev chain, Integer Quantum Hall, Chern Insulators, p-wave superconductors, Bott periodicity); Symmetry Protected Topological Phases; Fractional Quantum Hall Effect; Non-chiral Topological Order (String-net models, fusion category, anyons); Gauge Theories; Bosonization; Renormalization Group.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2017 Phase Transitions & Crit Phenomena (4 Credits)
Typically offered Spring
Surveys the theory of phase transitions and critical phenomena: phenomenology and experimental status; Ising and related models; phase diagrams; universality and scaling; expansion methods; exactly soluble models; mean-field theory; perturbation theory; introduction to renormalization group.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2022 Biophysics (4 Credits)
Typically offered Fall
This course focuses on the fundamental physical processes exploited by living organisms in the process of living. In particular, it introduces and develops elements of equilibrium and nonequilibrium statistical mechanics to explain how the molecular-scale components of cells store and process information, how they organize themselves into functional structures, and how these structures cooperatively endow cells with the ability to eat, move, respond to their environment, communicate, and reproduce.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2023 Special Topics (4 Credits)
Typically offered occasionally
Graduate-level advanced topic in Physics
Grading: GSAS Graded
Repeatable for additional credit: Yes

PHYS-GA 2027 Particle Physics (4 Credits)
Typically offered Fall and Spring
Experimental evidence on elementary particles and their interactions. Phenomenological models, electrons and photon-hadron interactions, weak decays and neutrino interactions, hadronic interactions, Effective field theories.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2030 Soft Matter I (4 Credits)
Typically offered occasionally
Advanced-level course on the principles and applications of soft matter physics. Emphasis on the underlying physical concepts and principles. Topics include interactions in soft mater systems (Van der Waals, aqueous electrostatics, depletion etc), polymers (flexibility and statistics, coils and globules, phase transitions, solutions, melts, networks, polyelectrolytes and polyampholytes), polymer dynamics (diffusion, reptation, viscoelasticity), biolopolymers (DNA electrostatics, melting, protein folding).
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2033 Special Topics (4 Credits)
Typically offered occasionally
Graduate-level advanced topic in Physics
Grading: GSAS Graded
Repeatable for additional credit: Yes

PHYS-GA 2040 Stars and Stellar Explosions (4 Credits)
Stars and stellar explosions are the basic building blocks of galaxies and play a pivotal role in the evolution of structure in the universe, in the nucleosynthesis of most elements, in the formation of compact objects (white dwarfs, neutron stars, and black holes), and as fundamental tools for measuring the early conditions and expansion of the universe over cosmic time (e.g., with Type Ia supernovae and gamma-ray bursts). This course will cover the observations and physics of stars and of their explosions. Primary topics will include energy transport and nuclear fusion in stars, stellar evolution and their deaths. The course will emphasize physical understanding and current open research problems, as well as connecting basic principles to observations. No previous coursework in astronomy is required, but a minimum standard undergrad-level advanced physics courses (thermodynamics, quantum mechanics, etc.) is encouraged.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2043 Special Topics (4 Credits)
Typically offered occasionally
Graduate-level advanced topic in Physics
Grading: GSAS Graded
Repeatable for additional credit: Yes

PHYS-GA 2048 Radiative Processes in Astrophysics (4 Credits)
Introduction to the radiative processes relevant to astronomy and astrophysics at the graduate level, including: energy transfer by radiation; classical and quantum theory of photon emission; bremsstrahlung; synchrotron radiation; Compton scattering; plasma e ects; and atomic and molecular electromagnetic transitions. We will refer to applications in current astrophysical research.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2050 High Energy Astrophysics (4 Credits)
Typically offered Fall and Spring
Fundamentals of high energy astrophysical phenomena and theory, including the physics of black holes, neutron stars and white dwarfs as well as relevant cosmological topics such as high-energy signatures of dark matter annihilation and prospects for their detection. Phenomena explored include active galactic nuclei (AGN), pulsars, supernovae and their remnants, gamma-ray bursts (GRBs), micro-quasars, magnetars, novae, accreting compact objects, relativistic jets, and high-energy cosmic rays.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2051 Extragalactic Astrophysics (4 Credits)
Typically offered Fall
Observational techniques in extragalactic astrophysics; phenomenology of globular clusters, galaxies, galaxy clusters, and quasars; stellar populations and chemical evolution of galaxies; fundamentals of stellar dynamics; and gravitational lensing.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2052 Cosmology (4 Credits)
Typically offered Spring term of odd numbered years
Homogeneous and Isotropic cosmology, acceleration of the Universe. Relativistic perturbation theory, generation of primordial fluctuations during Inflation. Gravitational Lensing. Cosmic Microwave Background Anisotropies. Baryon Acoustic Oscillations. Nonlinear evolution and perturbation theory. Galaxy clustering.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2053 Special Topics: (4 Credits)
Typically offered occasionally
Graduate-level advanced topic in Physics
Grading: GSAS Graded
Repeatable for additional credit: Yes

PHYS-GA 2058 Quantum Field Theory I (4 Credits)
Typically offered Fall
QFT I focuses on the basics of quantum field theory. It starts with the quantization of free spin-0, spin-1/2, and spin-1 fields, and basics of space-time symmetries. It continues with detailed discussion of relativistic perturbation theory, Feynman diagrams, and applications to scattering processes in quantum electrodynamics.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2059 Spec Topics: (4 Credits)
Typically offered occasionally
Advanced topics in many-body theory and statistical mechanics.
Grading: GSAS Graded
Repeatable for additional credit: Yes

PHYS-GA 2060 General Relativity (4 Credits)
Typically offered Fall and Spring
Tensor-spinor calculus, special and general theories, unified field theory, applications to relativistic physics and cosmology.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2061 Special Topics: (4 Credits)
Typically offered occasionally
Graduate-level advanced topic in Physics
Grading: GSAS Graded
Repeatable for additional credit: Yes

PHYS-GA 2063 Special Topics (4 Credits)
Typically offered occasionally
Graduate-level advanced topic in Physics
Grading: GSAS Graded
Repeatable for additional credit: Yes

PHYS-GA 2075 Advanced Experimental Physics (4 Credits)
Typically offered Fall and Spring
Experiments of historical and current interest conducted by the student. Methodology statistics, signal-to-noise ratio, and the significance of precision in measurement.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2077 Quantum Field Theory II (4 Credits)
Typically offered Spring
QFT II focuses on detailed description of non-Abelian gauge theories and their applications to quantum chromodynamics and the Standard Model of electroweak interactions. It covers topics such as the BRST quantization, spontaneous symmetry breaking, Higgs mechanism, and CP violation.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2078 Quantum Field Theory III (4 Credits)
Typically offered Fall
QFT III covers topics such as anomalies, solitons and instantons, lattice gauge theories, and finite temperature field theories. The course starts with detailed discussions of anomalies in various field theoretic models. It covers at great length nonperturbative techniques used to study solitons and instantons. The course also gives a description of gauge theories on a lattice, their applications to strong interactions, as well as field theories at finite temperature and their uses in particle physics and cosmology.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2079 Intro to String Theory (4 Credits)
Typically offered occasionally
First-quantized free-particle and random paths, the Nambu-Goto and Polyakov strings, Veneziano amplitudes. The classical bosonic string: old covariant approach, the no-ghost theorem and the existence of a critical dimensionality of space-time, gauge invariances. Light-cone formalism, the Hagedorn temperature. Modern covariant quantization, ghosts, and the BSRT symmetry. Global properties of string theory, multiloop diagrams and the moduli space, strings on curved backgrounds. The fermionic string: classical theory and world-sheet supersymmetry, the GSO projection, spectrum and space-time supersymmetry. Non-Abelian gauge symmetries in open strings. The heterotic string, compactifications on tori. Tree-level amplitudes in the fermionic and heterotic strings.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2080 Advanced Topics in String Theory (4 Credits)
Typically offered occasionally
Loop diagrams: the partition function of bosonic, fermionic, and heterotic strings. The a?0 limit: low-energy effective Lagrangians for the light modes, Calabi-Yau compactifications, N=1 supersymmetry and supersymmetry breaking. Extended space-time supersymmetry and the constraints on effective Lagrangians of the heterotic and closed superstrings. Conformal and superconformal invariance in two dimensions, the classification of minimal conformal theories. General classification of superstring compactifications. Cosmological solutions, 2-d black holes, the Liouville noncritical string. Fixed-t scattering at high energies, all-loop resummations. Random surfaces and 2-d Einstein gravity, topological field theory.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 2090 Practicum in Teaching Physics (0 Credits)
Typically offered Fall
Course designed to develop and enhance teaching skills of graduate students, with specific reference to the basic undergraduate courses in physics. Presentations by the students form the core of the course. Sessions are videotaped. Emphasis is on clarity of presentation and organization of recitation and laboratory materials. Topics include preparations for problem-solving sessions, encouragement of class participation and responses, and techniques for gauging student involvement. Specific content issues arising in elementary mechanics and electromagnetism are addressed. Use of texts, articles, and specially prepared sample materials.
Grading: GSAS Pass/Fail
Repeatable for additional credit: No

PHYS-GA 2091 Experimental Physics Rsc (1-9 Credits)
Typically offered Fall, Spring, and Summer terms
Faculty advisor-guided self-study involving experimental work
Grading: GSAS Graded
Repeatable for additional credit: Yes

PHYS-GA 2093 Theoretical Physics Rsch (1-9 Credits)
Typically offered Fall and Spring
Faculty advisor-guided self-study involving theoretical work
Grading: GSAS Graded
Repeatable for additional credit: Yes

PHYS-GA 2095 Research Reading (1-9 Credits)
Typically offered Fall, Spring, and January terms
Faculty advisor-guided self-study involving assigned reading work
Grading: GSAS Graded
Repeatable for additional credit: Yes

PHYS-GA 3307 Practical Training in Physics (1-8 Credits)
Typically offered Summer term
Course matches Ph.D. Physics students to pure or applied research laboratories, either in commercial venues or in national or international research centers. It gives students a chance to experience hands-on research and also application and development of research findings in an industrial or applied physics environment.
Grading: GSAS Graded
Repeatable for additional credit: Yes

PHYS-GA 7001 Introduction to Quantum Communication (3 Credits)
Quantum communication is a profoundly interdisciplinary field, drawing from the realms of quantum physics, information theory, classical communication and networking, as well as optical engineering, among others. The primary objective of this course is to equip students with the foundational knowledge necessary to embark on future independent research endeavors. This comprehensive course is structured into three main components. The first segment thoughtfully encompasses vital concepts selectively curated from diverse disciplines, including linear algebra, quantum physics, classical and quantum optics, and optical fiber communication. By doing so, it enables students to construct a coherent understanding of both quantum and classical communication. The second part delves deeply into quantum entanglement, a pivotal element in numerous quantum communication protocols. This section elucidates the concept of entanglement, explores experimental techniques for its generation, and surveys its multifaceted applications. Recognizing the burgeoning concerns surrounding the security of classical cryptography in the face of potential quantum computer-based attacks, the final portion of the course is dedicated to quantum cryptography, a highly developed facet of quantum communication. Here, we will delve into various quantum protocols, accompanying security validations, and practical implementations. Additionally, advanced topics, such as quantum hacking and device-independent quantum cryptography, will be addressed.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 9001 Multi-Wavelength Astronomy (4 Credits)
This course provides an overview of multi-messenger astronomy, focussing on three main aspects: multi-wavelength electromagnetic (EM) astronomy, particle/cosmic ray astronomy, and gravitational wave (GW) astronomy. The telescope technologies, data analysis, and the primary science questions relevant to each of these will be studied. For radiation, the telescope technologies at each wavelength will be discussed individually, as each region of the electromagnetic spectrum (radio, microwave, infrared, optical, ultraviolet, X-ray, and gamma-ray) requires different detection technologies and analysis techniques. Objects in space that produce radiation, gravitational waves and particles spanning many orders of magnitude in frequency/energy are studied. Different particle detectors (muon and neutrino/detectors, Imaging atmospheric Cherenkov telescopes) and GW detectors (e.g. LIGO, LISA) are reviewed. Each frequency range and domain tells us about different aspects of astronomical sources and the Universe as a whole. We will be studying the universe as it is seen at all wavelengths of light, and the methods we use to image and analyze this light. As well as electromagnetic radiation, we will also cover cosmic rays and the recently discovered gravitational waves, and consider predictions for future discoveries. The structure of the course is largely organized by wavelength and domain, and includes a significant lab / data reduction and analysis component. As a case study we will analyse observations of the first GW event with an EM counterpart, GW170817. A final research project will be carried out using data from state of the art telescopes. Imaging, spectroscopy, polarimetry and time variability are also introduced, for the 3 domains when appropriate. Telescope networks and global collaborations will be discussed, such as those set up for the electromagnetic follow-up of gravitational wave, particle, or high energy transient phenomena.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 9002 Particle Physics (4 Credits)
This is a graduate-level course in elementary particle physics. The course will survey the current understanding of particle properties and interactions, that is the Standard Model. The theoretical aspects will be presented together with the experimental evidence, and wherever possible, a description of the main detection systems used to arrive at the evidence will be given.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 9003 Theory of Galaxy Formation (4 Credits)
This course prepares the student for state-of-the-art research in galaxy formation and evolution. The course focusses on the physical processes underlying the formation and evolution of galaxies in a LCDM cosmology. Topics include Newtonian perturbation theory, the spherical collapse model, formation and structure of dark matter haloes (including Press-Schechter theory), the virial theorem, dynamical friction, cooling processes, theory of star formation, feedback processes, elements of stellar population synthesis, chemical evolution modeling, AGN, and supermassive black holes. The course also includes a detailed treatment of statistical tools used to describe the large-scale distribution of galaxies and introduces the student to the concepts of galaxy bias and halo occupation modeling. During the final lectures we will discuss a number of outstanding issues in galaxy formation, and the students will present and discuss their term paper on a current topic in the field of galaxy formation & evolution.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 9005 Single Molecule Biophysics (4 Credits)
This course introduces the students to the wealth of information on cellular processes gained using biophysical approaches that is not accessible using traditional techniques. Emphasis will be put on biologically relevant questions that state#of#the#art single molecule biophysical techniques were able to address. Topics include: biopolymer mechanics, protein#nucleic acid interaction, protein structure and dynamics, membrane dynamics, cytoskeletal dynamics, motor proteins, cell shape and motility, cell communication and cell#cell interaction, tissue mechanics. Understanding these processes will be framed within the realm of equilibrium and non#equilibrium statistical mechanics. Examples of single molecule experiments that allowed testing an extending concepts of statistical physics will be discussed.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 9006 Planet Formation and Evolution (4 Credits)
This course will present an overview of planetary formation and evolution, with particular focus on extrasolar systems. We will begin with a review of the solar system and the basic properties of extrasolar planetary systems. We will then study the formation and evolution of the host star in the context of the early stages of planet formation. We will focus on the evolution of the protoplanetary disk and its influence on planet growth and stability. Next we will explore planet formation and evolution of both gas-giant planets and terrestrial planets, including gravitational interactions and structural evolution. Finally, we will explore planetary atmospheres, focusing primarily on characterized extrasolar atmospheres. We will understand the underlying dynamics, radiative transfer, and observational constraints. Students will gain knowledge of several numerical techniques throughout the course by both developing a few numerical models of their own and also utilizing available numerical packages. The goal of the course is for students to become familiar with the current state of the art in the theory of planet formation and evolution. They should be able to understand content and context of current articles in the field and be prepared for introductory research in the field.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 9007 Fluid Mechanics (4 Credits)
Nearly all physical systems incorporate a large number of particles. However, it is not feasible to simultaneously solve the equations of motion of all components. Therefore, understanding their behavior requires treating their constituent particles as a fluid. This course will teach the concepts and techniques needed to describe and solve for the evolution of the bulk properties of a fluid for a wide range of realistic systems, broadly applicable to main areas of current research.
Grading: GSAS Graded
Repeatable for additional credit: No

- Bulletin Categories: Physics: Electives

PHYS-GA 9008 Research Rotations in Physics (4 Credits)
Students immerse into two seven#week research experiences during their first full semester on the NYU Abu Dhabi campus. One goal of the research rotations is to expose incoming students to different areas of research and potential PhD advisors. The course allows the student to gauge their interest in the subject area of research, the methods used, and the work environment in the research group, to determine if it is sufficient to sustain them for the duration of the dissertation.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 9009 Multi-Messenger Astronomy (4 Credits)
This course provides an overview of multi-messenger astronomy, focusing on three main aspects: multi-wavelength electromagnetic (EM) astronomy, particle/cosmic ray astronomy, and gravitational wave (GW) astronomy. The telescope technologies, data analysis, and the primary science questions relevant to each of these will be studied. For radiation, the telescope technologies at each wavelength will be discussed individually, as each region of the electromagnetic spectrum (radio, microwave, infrared, optical, ultraviolet, X-ray, and gamma-ray) requires different detection technologies and analysis techniques. Objects in space that produce radiation, gravitational waves and particles spanning many orders of magnitude in frequency/energy are studied. Different particle detectors (muon and neutrino/detectors, Imaging Atmospheric Cherenkov telescopes) and GW detectors (e.g. LIGO, LISA) are reviewed. Each frequency range and domain tells us about different aspects of astronomical sources and the Universe as a whole.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 9010 Physics of Living Systems (4 Credits)
Living cells, and tissues are governed by the laws of physics and chemistry. Yet their complexity, dynamism, and susceptibility to perturbations demand the development of new conceptual and experimental tools for their study. This course will cover experimental tools, physical concepts and mathematical frameworks that have been developed for the study of living systems. We will highlight how this toolkit can be used to understand the physics and chemistry underlying biologically relevant questions – i.e., questions crucial to understanding and controlling ourselves and the organisms we depend on.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 9011 Special Topics in General Relativity (3 Credits)
The goal of this course is to learn advanced topics in general rela4vity essen4al for pioneering research in classical and quantum gravity. The covered topics will go beyond what is usually taught in graduate and advanced undergraduate level general rela4vity. The course will go into the causal structure of space4me including no4ons of causality and Cauchy surfaces. It will build on this to introduce the Penrose and Hawking singularity theorems regarding the formation of black hole or cosmological singulari4es. Furthermore, the course will delve deeper into the physics of black holes, including their exo4c proper4es in higher dimensions as well as their thermodynamics features.
Grading: GSAS Graded
Repeatable for additional credit: No

PHYS-GA 9012 Standard Model of Particle Physics (4 Credits)
Typically offered Fall and Spring
Offered at NYUAD The goal of this course is to provide a modern introduction to the Standard Model of particle physics. Starting from the basic principle of Quantum Mechanics and Special Relativity, introducing the needed concepts of Quantum Field Theory (QFT) for particles of any spin smaller or equal than 2. Then build up the Standard Model by emphasizing the role of symmetries, especially broken symmetries to serve as a preamble towards a discussion of the electroweak and strong interactions. The major achievements and basic problems of the Standard Model are covered and a short introduction to the proposals for the physics beyond the Standard Model. The perspective of Effective Field Theories (EFT) is emphasized throughout and concrete examples for basic calculations are presented.
Grading: GSAS Graded
Repeatable for additional credit: No